MARS

BASE CAMP

4-H STEM CHALLENGE

YOUTH GUIDE

Getting Started

Welcome to your Mars Base Camp expedition! This will be an exciting opportunity for you to explore STEM through an expedition to Mars!

Each activity in Mars Base Camp is named for a different mission to Mars as a way to celebrate and explore all that we have learned about the red planet. In this guide we will explore each of the 2020 4-H STEM Challenge activities:

- Landing Zone *Surveyor*
- Red Planet *Odyssey*
- Crop *Curiosity*!
- *Insight* from Mars

Here is what you will find in your youth guide:

- Quick Guide Activity Sheet for each of the four activities
- Fact sheets and extra information that will help you complete your mission
- Career connections
- Notes page to take notes and write down ideas

Quick Guide for Landing Zone Surveyor

In this activity, you'll simulate the experience of arriving at Mars to conduct scientific exploration. Follow the instructions on this page to determine where you land on Mars, or whether you enter into orbit instead. Once you and your teammates know what parts of Mars you'll be exploring, use the Mars Scientist's Notebook on the next page to make observations.

Launch, Cruise and Approach Phase

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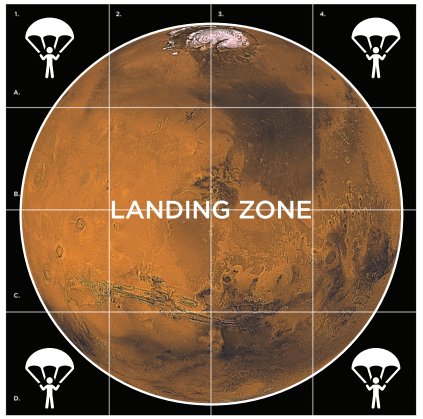
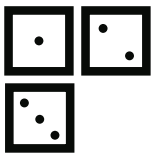
1. Lay the Mars map out on the floor and then designate a launch spot 3-5 feet away from the map. Mark the spot so you remember.
2. Initiate your countdown! T minus 3, 2, 1. Then launch ... After the countdown, launch your parachute toy, which is your landing device, towards Mars.
3. If you miss the target or land where someone else has already landed, go to the back of the line to try again.
4. If you land on an empty site on the target, move on to the "Orbit or Entry, Descent and Landing Phase"

Orbit or Entry, Descent and Landing Phase

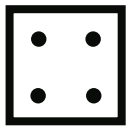


- Option One: If you went into orbit (A1, A4, D1 or D4), take the Landing Site Card that corresponds to your site and leave your marker in the correct position on the landing zone map.
- Option Two: If you land in the Mars surface Landing Zone, roll the die to see if you had a safe landing. If you did not land safely, go back to the Launch, Cruise and Approach Phase and try again. If you did land safely, take the Landing Site Card that corresponds to your site and leave your marker in the correct position on the map.



WHAT HAPPENED?
Congratulations, you successfully launched & landed!

WHAT TO DO NEXT?
Get card and place marker on map.



WHAT HAPPENED?
Sorry, you were hit by space debris and you crashed!

WHAT TO DO NEXT?
Go to the back of the line to try again.

WHAT HAPPENED?
Sorry, you landed upside down due to Martian winds and your rover is stuck!

WHAT TO DO NEXT?
Go to the back of the line to try again.

WHAT HAPPENED?
Sorry, your parachute did not deploy and you crashed!

WHAT TO DO NEXT?
Go to the back of the line to try again.

Mars Scientist's Notebook

Making careful observations and recording them is an important part of scientific discovery. Use these pages to write down and draw things you learned about Mars. Use information from your Landing Site Card, as well as information from the Landing Site Cards of your team mates. If you are missing a card for a section of Mars you'd like to explore, you can keep trying to land on that section until you succeed.

My Mars Discovery

Site Number:

Circle: I went into orbit I landed on the surface

My orbiter or landing site is called _____

Use this space to draw or write down something you noticed about your target.

Mars Surface Features

As you and your teammates discover new things about different orbits and landing sites on Mars, use the blank map below to write down your observations. Draw some features that you noticed on the surface of Mars.

- Label some Mars features that you learned about in this activity.
- Put a star in places that you want to learn more about.
- Circle places that you think would be good for people to try to land. Why would you pick those spots?

A1.	A2.	A3.	A4.
B1.	B2.	B3.	B4.
C1.	C2.	C3.	C4.
D1.	D2.	D3.	D4.

Scientific Reference Guide

Scientists practice using the right words to describe their discoveries so that they can share what they found with others. Here are some words that you can practice using in your notebook.

Craft that have been sent to Mars to collect information:

Orbiter

A spacecraft designed to revolve around a celestial body and collect information without landing on its surface. NASA's Mars Global Surveyor is pictured here.
Image Credit: Courtesy NASA/JPL-Caltech; Artwork Credit: Corby Waste.

Rover

A vehicle for exploring the surface of a planet or moon that typically collects information about the planet/moon's soil, rocks and any surface liquid. NASA's Mars Opportunity Rover is pictured here.
Image Credit: NASA.

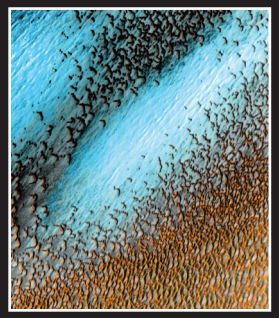
Lander

A spacecraft that is designed to land on a celestial body (such as the moon or a planet) and stay in one place. NASA's Viking 1 Lander is pictured here.
Image Credit: Courtesy NASA/JPL-Caltech.

Features scientists have observed on Mars

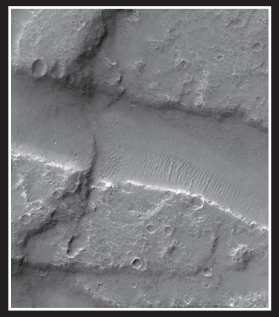
Channel

A feature of the landscape formed by flowing liquid, such as water or lava. A channel in the Xanthe Terra region of Mars is pictured here.
Image Credit: NASA/JPL-Caltech/ASU



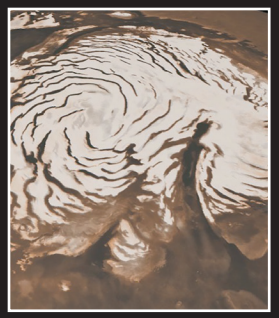
Dune

A mound of sand formed by the wind, usually along the beach or in a desert, that grows as sand accumulates. Dunes in Mars' North Polar Sand Sea are pictured here.
Image Credit: THEMIS NASA/JPL-Caltech/Arizona State University



Fault

A fracture in a planet's crust that appears when large blocks of rock slowly move past each other. Earthquakes can occur when the movement is faster. A small fault on Mars is pictured here.
Image Credit: NASA/JPL/University of Arizona



Ice cap

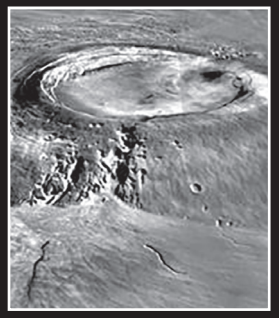
A glacier — a thick layer of ice and snow — that covers a large area and is typically found at the poles of a planet. Mars' North Polar Ice Cap is pictured here.

Image credit: NASA/JPL-Caltech/Malin Space Science System

Impact crater

A large depression or hole in the ground that is formed when impactors such as meteorites smash into a moon or planet's surface. A crater on Mars is pictured here.

Image credit: NASA/JPL-Caltech/Univ. of Arizona



Volcano

Openings in a planet's surface that release ash, gas and hot liquid rock (lava) in sometimes violent eruptions. Arsia Mons on Mars is pictured here.

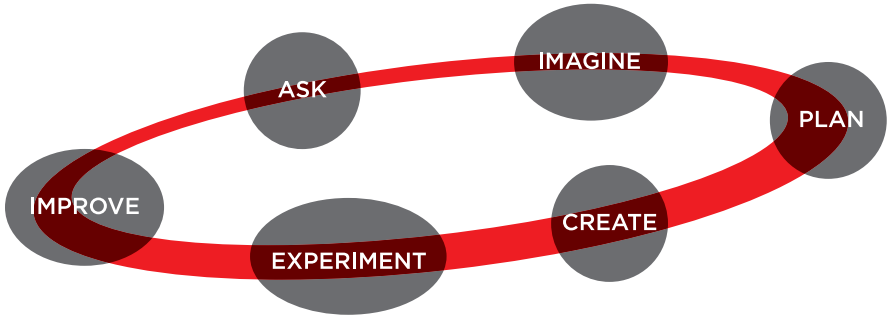
Image credit: NASA/MOLA Science Team

Quick Guide for Red Planet Odyssey

Use this quick start guide to complete the rover activity!

Design Brief for Building

As a team, you need to build a rover that will navigate the surface of Mars. The surface can be uneven and you may encounter features like hills or craters. Look through the Landing Zone Surveyor cards to familiarize yourself with some of the terrain that you might see. You will need to design a rover that can withstand some bumps and jarring. Even though you have some provided supplies, feel free to get creative with your rover, and add supplies as you see fit.

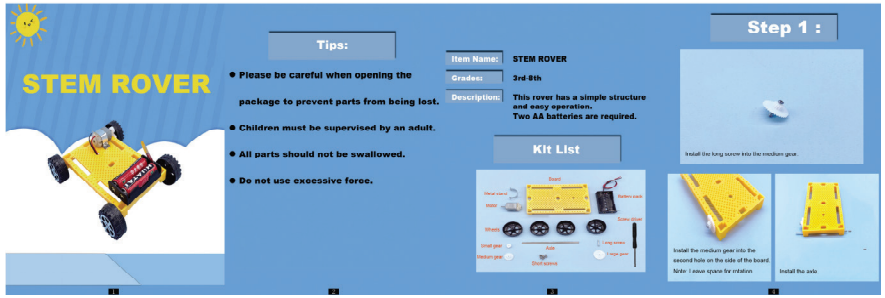


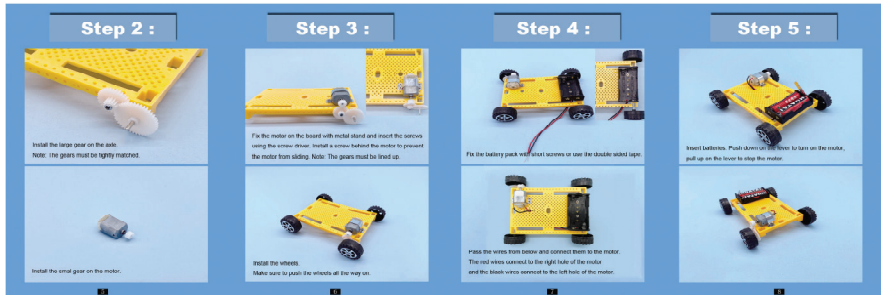
You will use the Engineering Design Process in this activity, which includes the following steps, to complete your Red Planet Odyssey. Just a reminder that the Engineering Design Process is cyclical, meaning you can complete the steps more than once. You also don't have to do every step each time you go through the process.

nasa.gov/audience/foreducators/best/edp.html

- **ASK:** Identify the problem, what you need to do, and what limits you might have. What problem are you trying to solve?
- **IMAGINE:** Think about what resources you have. Discuss in your group what you need to build the rover. Brainstorm ideas and ways that you can make this happen. Think of as many ideas as you can, with the materials that you have.
- **PLAN:** Choose the best two or three ideas and sketch your designs. Choose the best one to build!
- **CREATE:** Build a working model, or prototype, that aligns with what you need to do and the limits that you have identified.
- **TEST:** Try out your design. See if it works. Write down anything that needs to be improved.
- **IMPROVE:** Using your test, see what you need to make better. If you need to make changes, go back to the different steps in th

Need help or ideas with building your rover? Check out the instructions that came with your rover kit





Mission Brief

Now that you have built your rover, your team will need to navigate your rover from one part of Mars to another. To get started, lay the Mars map out on the floor. Use objects from around the room to create an obstacle course that mimics the features you might find on Mars.

We are starting from grid block: _____
We are ending at grid block:_____

Take a moment and look at the course. Discuss with your group the best way to get your rover from start to finish while avoiding any rough areas on the Martian surface. Use the information below to complete this process.

1. As a group, observe the Martian terrain that you will need to navigate. Work together to make note of tricky areas and obstacles.
2. Talk with your group and create a plan for how your rover will get from the starting point to your final destination.
3. Use available materials to create a path for your rover to guide it from the starting point to finishing point. The rover does not have sensors, so in order to guide it you will need to use physical objects. **TIP:** Once you put your rover down, you will not be able to touch it. You will use items like cups and straws to guide the rover. Think of this like a fence or a path that directs the rover around the obstacles and to its final destination.
4. Once your guide path is set, the rover can be put in place.
5. If the rover doesn't work the first time, take it out, redesign your guide path, or make modifications to your rover design

Quick Guide for Crop Curiosity

Use this quick start guide to complete the Mars agriculture activity!

Getting Started:

For two (playing against each other) or four (two players per team) players. If playing in teams, sit in a circle with teammates directly across from each other.

1. Decide on method of play:
   A. **MODULE COMPLETION:** win by completing module card first.
   B. **POINTS:** win by reaching a certain number of points first (2,000 recommended, winner gets remaining module components).
   C. **STRATEGY:** win by EITHER reaching a certain number of points OR collecting all module components first.

2. Shuffle the cards. Deal 11 cards to each player. Place the remaining cards face down in the center of the table, in a stockpile. Turn the top card over next to it to start a discard pile. If playing in teams, it is easiest if one player is in charge of the cards played on the table while the other is in charge of the module card/marker chips. Players should not show their cards to each other.

3. During a turn, players must do three things:
   A. Pick up a playing card. Normally, players pick up from the stock-pile, however, they may pick up the entire discard pile instead if they have at least two cards in their hand to match the top card on the discard pile (they then must play a "meld," defined below).
   B. Make any available plays as desired. This includes laying down "melds" (three-of-a-kind). If playing for points, disaster/sabotage cards may be placed on the table to acquire points instead of playing them against the other team.
   C. Discard a card. If a disaster/sabotage card is placed on the discard pile, it will work against the other team (see disaster/sabotage below).

4. Players may earn a module component (chip marker for the module card) by placing three cards of a kind or more (including no more than two wild cards) on the table. Players may lay down as many three-of-a-kind sets to earn as many module components as possible during the turn. Players may add matching cards or wild cards to sets already played on the table to work toward a Canasta (7 of a kind). If playing in teams, one teammate may add to the other's cards.

5. Players will eventually "go out" (run out of cards in their hand). When this happens, a new hand will start. This means that all points will need to be tallied and all cards (including played cards) will need to be shuffled and dealt out again to all players. New hands stop when someone wins the game as decided at the beginning (by completed module, by points, or whichever occurs first).

THREE CARDS OF A KIND: This is called a meld. Melds earn the corresponding module component (marker chip for module card). Ten different pieces must be earned to complete the module. Players may not take two of the same module components.

WILD CARDS: Can count as any type of card except sabotage or disaster. May be used to build three of a kind or build a Canasta. May not play more than two wild cards at a time in a single meld per turn.

CANASTA (seven cards of a kind):

When a Canasta is made, players may choose ONE of the following:

1. Steal a module component from the other player/team (take their chip and place it on your module card).
2. Collect a needed module component by marking it with a chip on your module card.
3. Pick up the entire discard pile.
4. Earn a 500 point bonus.

SABOTAGE: May be played against the other team/player by placing on the discard pile (counts as the discard) OR placed on the table to acquire points (does not count as discard). If used to play against the other team/person, the person playing the card may sabotage the other team/person's module by removing a module component chip and placing it back into the chip pile.

DISASTER: May be played against the other team/player by placing on the discard pile (counts as the discard) OR placed on the table to acquire points (does not count as discard). If used to play against the other person/team, the next player to take a turn may not pick up the discard pile.

Keep Score Here:

Distance from the Sun
228 million km

Length of day
24 hours 37 minutes

Length of year
687 Earth days

Average temperature
-62.7 °C

Atmosphere composition
Carbon Dioxide, Argon, some Water Vapor

Gravity
3.7 m/s² • 38% of Earth

Soil pH
8-9

Soil composition
Sodium, Potassium, Chloride, Magnesium

% of the surface that is water
14% (all ice)

Diameter
6,779 km

Distance from the Sun
150 million km

Length of day
23 hours 56 minutes

Length of year
365.25 days

Average temperature
13.8 °C

Atmosphere composition
Nitrogen, Oxygen, Carbon Dioxide, Argon

Gravity
9.8 m/s²

Soil pH
6.5

Soil composition
Nitrogen, Potassium, Calcium, Phosphorus

% of the surface that is water
71% (3.5% fresh water)

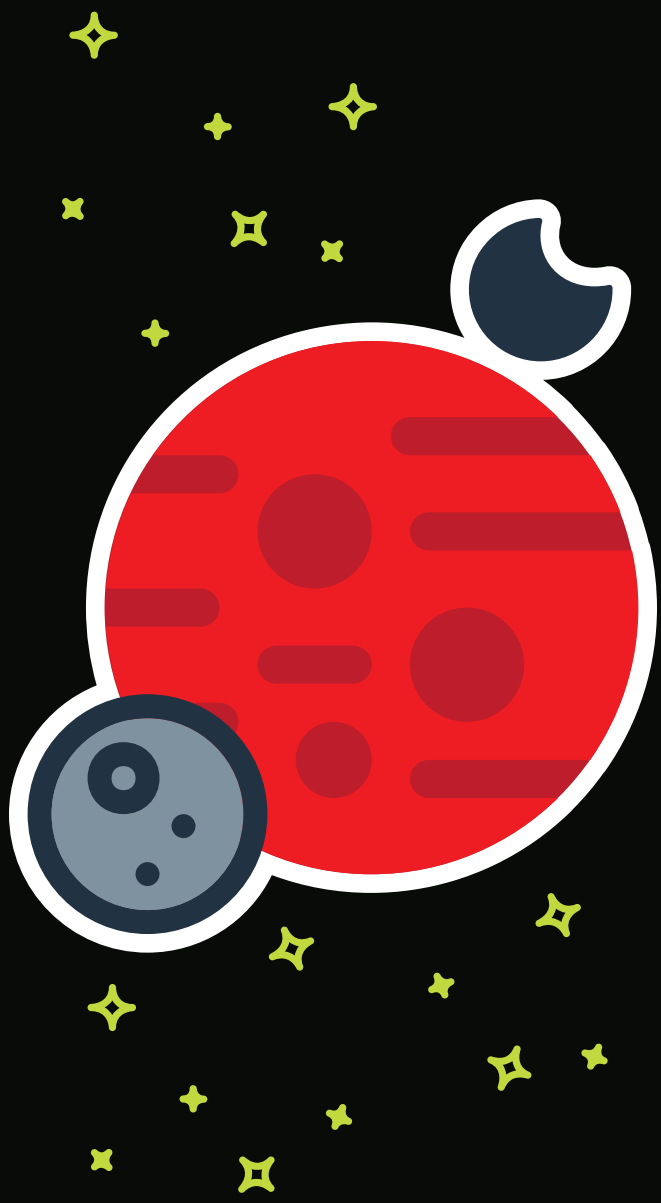
Diameter
12,742 km

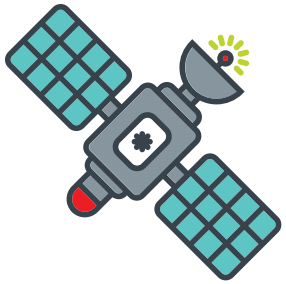
Quick Guide for Insight from Mars

Insight from Mars is an introductory coding activity where you'll learn how to use code to present an interesting thing you've discovered about Mars. You'll use an introductory computer science platform called Scratch to code and animate an imaginative story that will teach your friends and family back on Earth about what you've discovered on Mars.

Visit **4-H.org/InsightfromMars** to get started!

If you don't have access to the internet but do have a computer, you can install the offline Scratch program from the USB drive included in this kit. You'll also find a rover Sprite and Mars backdrop to get you started!





Space Operations Officer: United States Space Force

4-H Pillar Tie-In: STEM

The United States Space Force is a new branch of the Armed Forces. You might be surprised to learn that most of what Space Force does affects us on the ground. That's because the satellites in orbit around Earth affect almost everything people do every day. As we like to say, there's no such thing as a day without space.

Satellites don't just control the GPS maps app on your phone. ATMs, the stock exchange, gas pumps, traffic lights and power grids are just the beginning. In purely military applications, satellites help us with ground combat control, guided missiles, surveillance and every piece of global communication.

UNITED STATES
SPACE FORCE

In Space Force, we launch rockets and manage space debris orbiting around Earth. The debris field requires constant tracking because at 17,000 mph, a piece of metal the size of a coin in orbit isn't junk. It's a missile.

As you might guess, some of what we do is classified. As commerce and exploration expand into our solar system, we're developing ways to stay ahead of the future and protect that expansion. Asteroid mining and 3D printing bases on the moon aren't science fiction anymore.

Learn more about Space Force here: *airforce.com/spaceforce*

Space Physiologist: NASA

4-H Pillar Tie-In: Healthy Living

Did you know that living in space can have dramatic effects on the body?

Think about this: Astronauts in space are living beyond the effects of the Earth's gravity. That means they are weightless, and their bodies no longer need to exert nearly as much energy to stand, walk or even lift a finger. Without the constant exercise of existing in a world with gravity, astronauts can quickly lose muscle mass and bone density that is critical to remaining healthy on Earth. Studies have shown that astronauts experience up to a 20 percent loss of muscle mass on space flights lasting five to 11 days! To put that in perspective, a one-way trip to Mars would take approximately seven months. Because of this - and many other health challenges related to living in space - NASA and other space agencies need all sorts of scientists and engineers to figure out how astronauts can get the nutrition and exercise they need to stay healthy.

To support astronauts, scientists and engineers from NASA's Human Research Program study how the human body reacts to the unique challenges of living in space. Their goal is to understand the ways space travel can harm the body, then develop and test solutions that make it safer. These researchers develop solutions to support all aspects of the human body, including bone health, muscle function, cardiovascular response, sensorimotor systems, immunology, and behavioral health.

More information about space physiology can be found here: *nasa.gov/exploration/humanresearch/areas_study/physiology*

Space Agronomist: NASA

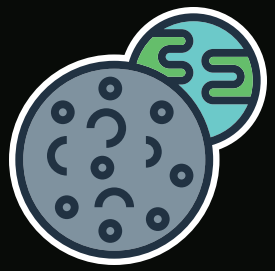
4-H Pillar Tie-In: Agriculture

Plants have evolved over hundreds of millions of years to thrive on earth. Like humans, they are optimized to exist in a very specific set of conditions that are unique to this planet, including the force of gravity, the composition of the atmosphere, the intensity of solar radiation and the mineral composition of the soil. And although some of these variables do change somewhat across different environments on Earth, the differences are relatively small.

In space and on other planets, all these variables are different from how they are on Earth. That makes growing plants in space much more difficult, which is where space agronomists come to the rescue. Imagine taking a potted plant and putting it in a spacecraft with zero gravity. The soil would float away and make a mess. Water would form a sphere and float away, too. Without gravity, the plant may even grow differently (if it could grow at all). Space agronomists conduct research to figure out how plants can thrive in the harsh conditions of space. Part of their work is to figure out which crops might grow best in space and still provide necessary nutrition to astronauts. They may conduct experiments and breed new plant varieties to create the most efficient, nutritious and low-effort crops for astronauts to grow. They also may work with engineers to design specialized growing modules that allow plants to grow on spaceships or on other planets.

Through these efforts, space agronomists are helping enable deep-space travel— including a mission to Mars. Without the ability to grow food in space, humans would be unable to explore the further reaches of our solar system and other planets. And not only that, many of the innovations pioneered by space agronomists are ultimately used to make growing crops on Earth more efficient, like precision watering, LED grow-lighting and automated moisture detection systems.

Learn more about growing plants in space here:
nasa.gov/content/growing-plants-in-space



Artificial Intelligence Engineer: Google

4-H Pillar Tie-In: Civic Engagement and STEM

Artificial intelligence, or AI, has many different applications, and space exploration is no exception. For example, engineers at Google are helping NASA researchers use an AI technique called a neural network to help determine which exoplanets (planets orbiting stars other than our sun) could have atmospheric conditions that are hospitable to life. Even though exoplanets are many lightyears away, AI tools can help researchers quickly identify molecules in the atmosphere based on the wavelengths of light that are emitted or absorbed. This helps researchers which planets are most promising, and therefore worth studying further.

Google engineers are also working with NASA researchers to advance the field of quantum computing, which harnesses the unique properties of subatomic particles (meaning they are even smaller than atoms) to perform extremely fast computing tasks. Researchers believe that quantum computing will one day enable breakthroughs in nearly every aspect of space exploration, from navigation, to data analysis, to advanced manufacturing. In 2019, Google and NASA engineers demonstrated quantum supremacy, which means they were able to use a quantum computer to quickly solve a problem that not even the most advanced supercomputers in the world can solve.

Learn more about how Google and NASA are using AI and quantum computing to advance space exploration here:
nasa.gov/feature/ames/quantum-supremacy/

Notes:

Congratulations

for completing the 2020 4-H STEM Challenge.

Presented by

Date

MARS BASE CAMP

4-H STEM CHALLENGE

4-H STEM Challenge

Program supported by:

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In 4-H, we believe in the power of young people. We see that every child has valuable strengths and real influence to improve the world around us. We are America's largest youth development organization—empowering nearly six million young people across the U.S. with the skills to lead for a lifetime.

Learn more online at: **4-H.org/STEMChallenge**